CS 580-01 Spring 2025’s Course Progress Notes

**Major Topics Covered**

* Algorithms and Design (SDF)
  + Concept and properties of algorithms, \_\_\_\_
  + Role of algorithms,\_
  + Problem-solving strategies,
  + Separation of behavior and implementation
* Basis Analysis (AL)
  + Asymptotic Analysis, empirical measurement.
  + Differences among best, average, and worst case behaviors of an algorithm.
  + Complexity classes, such as constant, logarithmic linear, quadratic, and exponential.
  + Recurrence Relations and their solutions.
  + Time and space trade-offs in algorithms.
* Algorithmic Strategies (AL)
  + Brute-force, divide-and-conquer, transformation, greedy, dynamic programming, heuristics
* Fundamental Data Structures and Algorithms (AL)
  + Binary search, Insertion sort, Selection sort, Shell sort, Quicksort, Mergesort, Heapsort.
  + Binary heaps, Binary search trees, hashing.
  + Representations of graphs and Trade-offs
  + Fundamental graph algorithms including BFS and DFS, Shortest paths, and Minimum spanning trees.
  + Substring search, Pattern matching.
* Basic Automata, Computability and Complexity (AL)
  + Finite-state machines, Regular expressions
  + Complexity classes P, NP, NP-completeness, NP-complete problems, reductions
* Advanced Data Structures, Algorithms and Analysis (AL)
  + Balanced trees (e.g., Balanced search trees, AVL-trees, Red-Black Trees, B-trees)
  + Graphs (Topological sort, Strongly connected components)
  + Advanced data structures (disjoint sets, mergeable heaps) [optional]
  + Network flows
  + Linear programming
  + Polynomials and the FFT
  + Number-theoretic algorithms including Primality testing, RSA public-key cryptosystem
  + Approximation algorithms including TSP
  + Computational geometry including Convex hull, Geometric search and intersection
  + Randomized algorithms such as, Rabin-Karp string matching, String sorts, Tries
  + Data compression. [optional]
* Parallel algorithms, analysis and programming (PD) [optional]
* Formal Models and Semantics (PD) [optional]